

# Symbols

(Manuscript received October 20, 1953)

The following list gives the symbols used through the several articles appearing in this issue of the JOURNAL. The list does not include all the variant forms of the different symbols distinguished by subscripts, as these distinctions are indicated in the context where they are used.

## MECHANICAL:

- $a$  Cross sectional area
- $\ell$  Length
- $m$  Effective armature mass
- $T$  Kinetic energy
- $V$  Work done to overcome static load
- $x$  Armature displacement

## ELECTRICAL:

- $e$  Copper efficiency or fraction of the copper volume occupied by conductor
- $E$  Applied battery voltage
- $G$  Total equivalent single turn conductance
- $G_c$  Equivalent single turn conductance of coil;  $N^2/R$
- $G_E$  Equivalent single turn eddy current conductance
- $G'_E$  Effective single turn eddy current conductance;  $G_E e^{-G_E / (G_c + G_E)}$
- $G_s$  Equivalent single turn conductance of sleeve
- $i$  Instantaneous current
- $I$  Steady state current
- $m$  Mean length of turn in winding
- $N$  Number of turns in winding
- $L_1$  Single turn inductance;  $\frac{4\pi}{\alpha'(x)}$
- $NI$  Ampere turns
- $NI_0$  Just operate or just release ampere turn value
- $q$  Ratio of just operate to final ampere turns;  $\frac{NI_0}{NI}$

$\rho$	Resistivity of material
$R$	Resistance
$S$	Coil volume
$v$	Ratio of flux attained at time $t$ to steady state flux
$W$	Power; $I^2R$

## MAGNETIC:

$A$	Equivalent pole face area
$A_2$	Effective pole face area (design value)
$B$	Induction (flux density)
$B'$	Value of $B$ for maximum permeability
$B''$	Saturation density
$B_M$	Density at $\mu = 1000$
$B_R$	Remanence (density at $H = 0$ )
$C_L$	$\frac{\mathfrak{R}_0 + \mathfrak{R}_L}{\mathfrak{R}_0}$
$F$	Magnetic pull
$\mathfrak{F}$	Magnetomotive force; $4\pi NI$
$\mathfrak{F}_C$	Coercive magnetomotive force
$H$	Field intensity
$H_C$	Coercive force
$L$	Inductance
$\mu$	Permeability
$\mu_A$	Permeability of air
$\mu'$	Maximum value of permeability
$\mathfrak{R}$	Reluctance
$\mathfrak{R}_C$	Reluctance of the core
$\mathfrak{R}'_C$	Minimum value of core reluctance
$\mathfrak{R}_1$	$\mathfrak{R}(x)$ for $x = x_1$
$\mathfrak{R}_i$	Initial incremental reluctance
$\mathfrak{R}_0$	Equivalent closed gap reluctance
$\mathfrak{R}_L$	Equivalent leakage reluctance
$\mathfrak{R}_{L2}$	Effective leakage reluctance (design value)
$\mathfrak{R}_{02}$	Effective closed gap reluctance (design value)
$\mathfrak{R}(x)$	Equivalent relay reluctance $\frac{\mathfrak{R}_L \left( \mathfrak{R}_0 + \frac{x}{A} \right)}{\mathfrak{R}_0 + \mathfrak{R}_L + \frac{x}{A}}$
$\varphi$	flux
$\Phi$	Steady state flux

$\varphi_1$	Initial equilibrium flux
$\varphi'$	Flux for maximum permeability or minimum reluctance
$\varphi''$	Flux at saturation
$\varphi_0$	Residual flux
$\varphi_g$	Gap flux
$U$	Field energy
$u$	$x/A\mathcal{R}_0$ or $x/x_0$
$W$	Mechanical work done by magnet
$x_0$	$A\mathcal{R}_0$

## TIME:

$t$	Time
$t_0$	Operate or release time
$t_1$	Waiting time
$t_2$	Motion time
$t_3$	Stagger time
$t_E$	Eddy current time constant; $L_1 G'_E$
$t_C$	Winding time constant; $L_1 G_C$
$t_S$	Sleeve time constant; $L_1 G_S$